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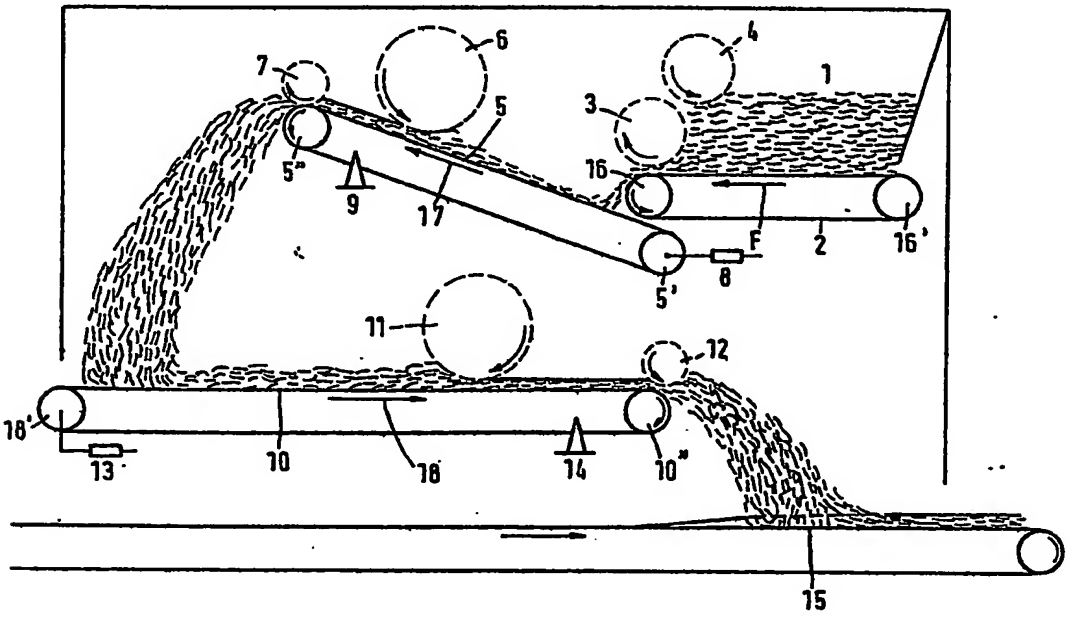
# (54) Method of and device for metering bulk material

(57) Bulk material containing lignocellulose, such as wood chips etc., particularly for cement-bound wood particle boards, is controllably discharged from a bin (1), subjected on a premetering belt (5) to a first metering by volume by skimming roller (6) and weight by load cells (8) and is spread onto a fine metering belt (10) where it is metered a second time by volume by skimming roller (11) and weight by load cell (13). The weight-dependent pulses of measuring device (8) are used to control the discharge speed of the bin discharge belt (2) and the weight-dependent pulses from the measuring device (13) are used to control the speed and thus the bulk quantity of the premetering belt (5). This results in the optimally uniform spreading of the bulk material according to the height and width of the preform and thus in optimally uniform finished hardboards.



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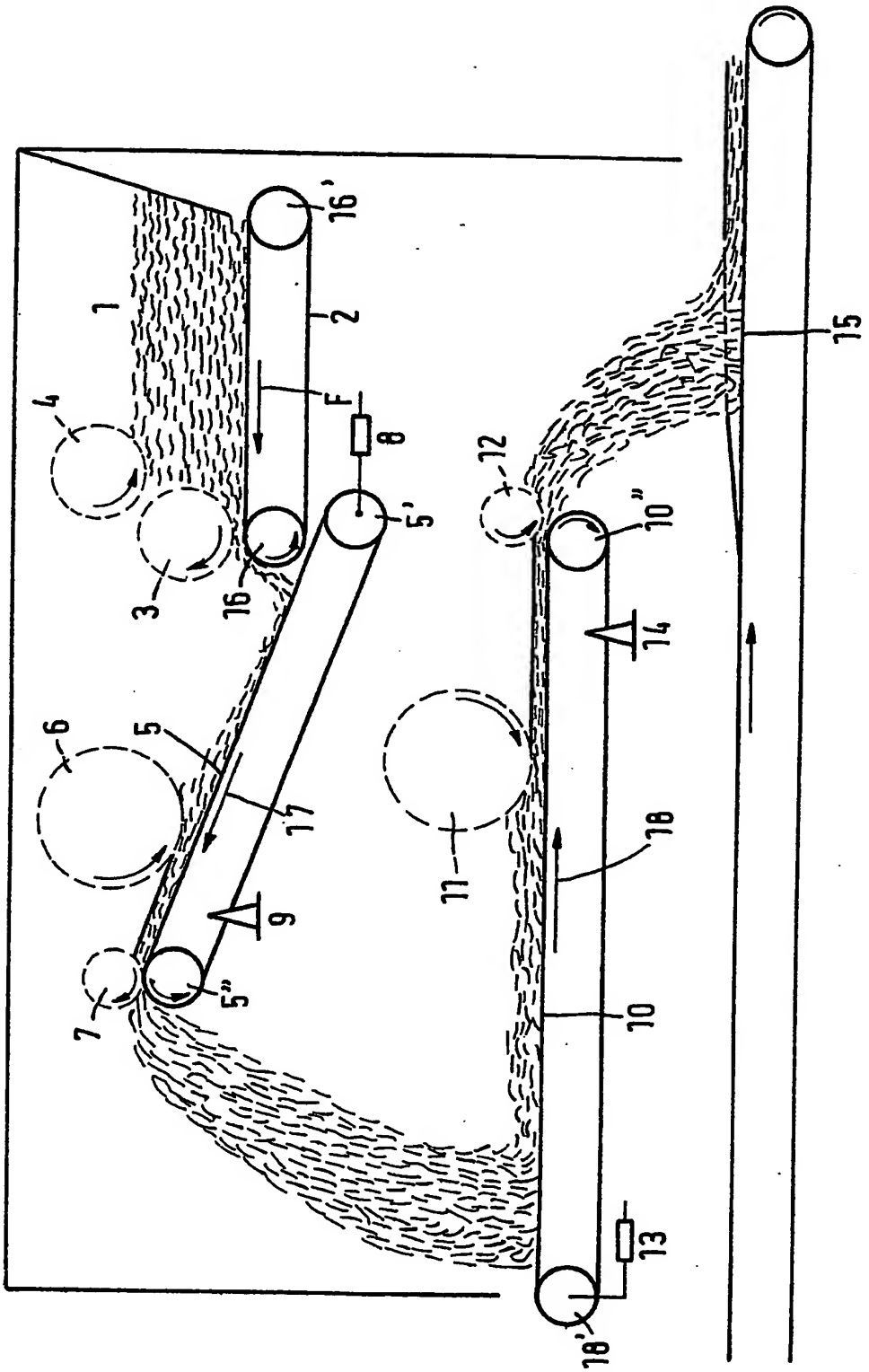

SPECIFICATION

**Method of and device for metering bulk material**

The invention relates to a method of metering thin, small-piece bulk material containing lignocellulose, such as wood, bagasse or similar chips, wood fibres etc., particularly for the manufacture of cement-bound wood particle boards, in which the bulk material is discharged from a bin and then volumetrically metered on a circulating belt and brought through a spreading device, such as a spreading roller, onto a forming belt, having a bin for the bulk material which is provided with binding agent, particularly cement, with at least one discharge device, such as discharge rollers, discharge belt or similar, and a downstream metering belt on which is disposed at least one volumetric metering device, for example a skimming roller, which influences the weight and/or the volume of the bulk material, said metering device being followed at the end of the metering belt by a spreading device, such as a spreading roller or similar.

In the manufacture of hardboards, such as particle boards, particularly cement-bound particle boards, the conventional procedure has been that the particles stored in a bin, such as a hopper or silo, and provided with binding agent, or particles mixed with cement in the case of cement-bound particle boards, are brought by a discharge device, for example a discharge roller co-operating with a discharge belt, onto a downstream conveyor belt. The discharged quantity of bulk material is metered by weight either cycle-by-cycle on the entire belt of a belt section or volume metered, and is then spread by a spreading device, for example by air separation or by a gravity spreading device, onto the forming belt which accepts the preform which is subsequently to be pressed. With regard to the quality of the finished boards it is very important that the forms, cakes or mats which are spread onto the forming belt are uniform in terms of height, density and structure (inter-weaving, felting, interlacing etc) so that the finished board has a structure which is as uniform as possible over its entire cross section. Therefore, it is important that the particles which are wetted with binding agents, particularly cement, be distributed during manufacture as uniformly as possible on the forming belt in width and length.

The particle board industry employs two known methods, namely the so-called volumetric metering of the bulk material or its metering by weight. It is also known to combine volumetric metering and metering by weight.

For volumetric metering, use is made usually of so-called metering rollers, also called skimming rollers, which are height-adjustable in relation to the conveyor belt transporting the bulk material. Depending on the height of such a metering roller in relation to the conveyor belt or metering belt transporting the bulk material below, there results a variable cross section, a so-called metering slit, through which the bulk material can pass in uniform height, i.e. volumetrically metered. The speed of the conveyor belt conveying the bulk material and the height of the metering slit for the bulk material, i.e. the height of the metering or skimming roller, result in the volumetric quantity of bulk material which is spread onto the actual forming belt for the formation of the preform, cake or mat.

A considerable disadvantage of this method is that the bulk material accumulates in front of the metering roller which, as already mentioned, is usually in the form of a skimming roller, as a result of which there is a separation, demixing or buildup of the bulk material such that the bottom-most layers of the bulk material on the forming belt exhibit a much higher bulk weight than the upper layers as a result of the fines and superfines which accummulate there and/or as a result of pile-up. This changes the uniform composition and thus the mass-related quantity of bulk material, which considerably affects the uniformity and accuracy of the spread preform and thus the desired uniform composition of the finished board and, consequently, its strength characteristics.

This disadvantage is even more pronounced in the case of cement-bound boards than in the case of particle boards provided with binding agents, such as glue, because in the case of cement-bound boards as a result of the cement component the bulk weights are 1 1/2 to 2 1/2 times as great as in the case of particle boards bound with glue. Accordingly, as a result of the greater weight, i.e. the greater mass of the bulk material mixed with cement, the above-described disadvantage is even more pronounced in the case of falling and throwing with the result that there are even greater deviations of the mass per unit of volume.

In the known methods, metering by weight is carried out either continuously, for example by means of a conveyor-type weigher, or intermittently, e.g. by means of a cyclic weigher. In practice, the continuous systems employing a conveyor-type weigher or radioactive weight monitoring are gaining ground. In systems with a conveyor-type weigher the quantity of bulk material per unit of time is precisely determined, but the uniform discharge of the bulk material and its distribution on the forming belt are in no way guaranteed. One of the causes of this is that in the systems with a conveyor-type weigher the bulk material is usually brought onto the conveyor-type weigher by way of volumetric metering with a vibrating conveyor. Since, however, the conveyor-type weigher has a limited length and reacts to the total weight of the bulk material, it cannot cope with the fluctuations in time and/or space of the weight of the bulk material.

The distance in time and space between the pulse generator, i.e. the conveyor-type weigher, and the actuator influenced by this conveyor-type weigher, i.e. the metering roller (skimming roller) results in inevitable non-uniformity and inaccuracy in the flow of bulk material. These irregularities are incorporated directly into the spread preform and thus into the finished board.

The problems are similar with the known systems which employ radioactive isotopes for measuring the weight of the bulk material. As pulse generators, these measuring devices control either a metering roller (skimming roller), as is known from volumetric

metering, or a height-adjustable skimmer, scraper or similar actuator which can be viewed as having the same effect as a metering roller with regard to its operating principle. In both cases, there is a build-up of the bulk material in front of such an actuator with the consequent disadvantages already described in the discussion of volumetric metering.

It has been shown that in both above-described known metering methods the variations of spreading, expressed by the area density, are more than ± 6% in one and the same board and more than ± 4% from board to board. Such great variations in the raw density in one and the same board and from board to board result in considerable disadvantages, firstly in the manufacture of the board, particularly during the actual pressing operation, during the swelling of the board and afterwards during the processing of the boards, for example during smoothing, cutting, milling etc.

The object of the invention is to further develop a method of the initially mentioned type so that hardboards, particularly cement-bound particle boards, of identical, optimum spreading and thus of equal height, density and structure can be manufactured in factories and the depicted variations in the spreading of the boards are prevented.

The invention provides a method of metering bulk material for the manufacture of cement-bound wood particle boards, in which the bulk material is discharged from a bin and then volumetrically metered on a circulating belt and brought through a spreading device onto a forming belt, wherein the bulk material is weighed and volumetrically metered on a premetering belt and is then spread onto a downstream fine metering belt on which it is again weighed and volumetrically metered, and is then spread onto the downstream forming belt.

It is also the object of the invention to create a device for implementing such a method, said device being suitable for the series production of hardboards provided with binding agent, particularly cement-bound particle boards, which, while providing a simple construction and rational working method, permits the optimum, uniform manufacture of boards in respect of height, density and structure.

The invention also provides a device for metering bulk material for the manufacture of cement-bound wood particle boards, having a bin for the bulk material, at least one discharge device, and a downstream metering belt on which is disposed at least one volumetric metering device and a spreading device, wherein disposed in the spreading region of a spreading device of a premetering belt is a fine metering belt, with a respective spreading device, and a respective volumetric metering device, wherein the premetering belt and the fine metering belt are each provided with a weight-measuring means for the bulk material thereon.

The method and device according to the invention make it possible for particle boards, particularly cement-bound particle boards, to be metered with optimum uniformity at the factory with regard to the ready-mixed bulk material such that in its width and in its length, i.e. over the entire cross section of the board, the bulk material is present in uniform height, density, distribution and structure. In particular, this eliminates the previously accepted demixing and accumulation of the material as a result of volumetric metering and the consequent (particularly in the case of cement-bound wood particle boards) variations of spreading and thus the variations with regard to the strength values of the finished board, particularly the bending and transverse tensile strengths.

The method according to the invention and a device according to the invention for implementing the method are described in greater detail below with reference to a specimen embodiment shown in the accompanying drawing.

The drawing shows a bin 1, for example a hopper, silo or similar, for the bulk material, particularly for cement-bound particles. In the lower region of the bin 1 there is a discharge belt 2 which moves to the left in the direction of arrow F and is driven by the roller 16 and also runs over roller 16'. In the front region of this discharge belt 2 there is a discharge roller 3 which co-operates with the latter and rotates in the direction of the arrow, and which can, for its part, interact with a counter-rotating skimming roller 4.

The bulk material discharged from the bin 1 by means of this discharge device 2,3 passes onto a first conveyor belt 5 which is termed the premetering belt. The premetering belt 5 is driven by a drive roller 5" and also runs over a positionally movable idler roller 5'. In front of the drive roller 5" there is a volumetric metering device in the form of a skimming roller 6 rotating in the direction of the arrow. It can be seen that the bulk material accumulates somewhat in the region before the skimming roller 6 due to the premetering belt 5 running in the direction of arrow 17. To prevent an extreme accumulation of the bulk material in this region, which would cause the demixing of the bulk material as is the case in customary devices, the premetering belt 5 is fixed by means of a support 9, preferably between the skimming roller 6 and the front drive roller 5". The support is shown in diagrammatic form and may be a transverse shaft (not shown in greater detail) which is supported in a fixed manner on either side of the metering belt 5. The premetering belt 5, which is thus supported in its front region is connected in the region of the idler roller 5', to a load cell 8 which measures the weight of the bulk material on the belt 5. Due to the off-centre mounting of belt 5 on support 9, and the distant location of the load cell 8 the inflowing quantity of material is measured faster and more accurately, and the sensitivity of the weighing device is considerably enhanced.

In the front region of the premetering belt 5 there is, in known manner, a spreading device, e.g. a spreading roller 7, for the bulk material coming into the area of this spreading device, said bulk material having been premetered by volume and by weight on the premetering belt by the above described arrangement. Instead of a spreading roller 7 it is also possible to provide other spreading means which are suitable for spreading the bulk material.

The load cell 8 is connected control-wise to the drive for the discharge device 2,3 particularly to the

discharge belt 2 of the bin 1. Due to this arrangement of the metering belt 5 through the provision of a weighing means, for example the load cell 8 on this premetering belt 5, the bulk material on the premetering belt 5 is measured by weight and the measured weight values are transmitted via the measuring device 8, directly to the drive of the discharge belt 2 so that there is a constant weight of bulk material per unit of time on the premetering belt 5.

Furthermore, this bulk material is volumetrically metered once again by means of the skimming roller 6 and is thus smoothed, as a result of which control-related fluctuations in the weight of the bulk material are largely prevented.

The bulk material, whose weight is thus kept even per unit time on the premetering belt 5, comes, after it has been smoothed by the skimming roller 6, into the area of the spreading device in the form of the spreading roller 7. As a result of this the bulk material is again finely distributed and spread onto the fine metering belt 10 which is downstream of the premetering belt 5. This fine metering belt 10, which circulates in the direction of arrow 18, is driven by the front drive roller 10" and also runs over the positionally movable idler roller 10', is likewise equipped in its front region with a skimming roller 11. The latter, just like the skimming roller 6 of the premetering belt 5, may be height-adjustable. Furthermore, in the region between skimming roller 11 and front spreading device 12, which is likewise a spreading roller, the fine metering belt 10 is provided with a stationary support 14. The stationary support may, like the stationary support 9, be in the form of a transverse shaft supported at its ends.

The thus supported fine metering belt 10 is, in the region of the idler roller 10', likewise provided with a means for measuring the bulk weight falling onto the fine metering belt 10, in the form of a load cell 13.

Prior to the actual spreading of the pre-form, cake or mat onto the final forming belt 15, the finely distributed bulk material coming from the premetering belt 5 is measured by weight once again by the arrangement of the fine metering belt 10, the support 14 and the weight-measuring device in the form of a load cell 13, and is volumetrically fine-metered by means of the skimming roller 11. Consequently, the quantity of bulk material escaping per unit time from the metering slit between fine metering belt 10 and skimming roller 11 is metered in terms of volume and weight and then comes into the area of the spreading device 12 which is likewise in the form of a simple spreading roller. The particles ejected by this spreading roller 12 then come directly onto the actual forming belt 15 where they become a preform.

The monitoring of the bulk material discharged per unit of time onto the fine metering belt 10 takes place, therefore, via the load cell 13 which measures the weight and which supplies its pulses to the driving mechanism for the drive roller 5" of the premetering belt 5, controlling the speed of the latter. Through appropriate control of the speed of the premetering belt 5 the quantity of bulk material conveyed on this premetering belt 5 is also controlled, as a result of which the formation of a buildup of bulk material in front of the skimming roller 6 is prevented. In this way, the flow of bulk material to the spreading device 12 at the end of the fine metering belt 10 is precisely defined in terms of weight and is always uniform. The load cell 13, therefore, has the task of regulating the quantity of bulk material by changing the speed of the premetering belt 5 so that there is no major buildup in front of the skimming roller 11, but that there is sufficient bulk material on the fine metering belt 10 whereby this quantity of bulk material can always be kept constant.

The speeds of all drive rollers, i.e. of the rollers 16,5" and 10", are adjustable. Likewise, the speed and position of the discharge roller 3 and of the skimming rollers 6 and 11 in relation to the respective belts 5 and 10 are adjustable, in such a way that a constant setting is guaranteed. This also allows simple adaptation to all types of wood and to all mix ratios with the result that the method and the device are suitable also for different bulk materials and binding agents. The invention is of particular advantage, for example, in the case of very light wood, such as balsawood, whose particle volume is up to five times the size of that of normal wood.

The invention obviates the initially depicted disadvantages of the known methods in that it permits optimum distribution of the bulk material by means of a first volumetric metering in the bin by the discharge roller 3, by a second volumetric metering on the premetering belt by the skimming roller 6 and by a third volumetric metering on the fine metering belt by the skimming roller 11 and by twice checking of the area weights by the weight-measuring means 8,13 which have the form of load cells. Due to the fact that there is virtually no buildup of bulk material in the area of the volumetric metering, namely in the area of the skimming rollers 6 and 11, the density of the bulk material on the fine metering belt 10 is extremely uniform both transverse as well as longitudinal to the conveying direction of the belt. This results in a previously unattained spreading accuracy, which comes particularly to the fore in the case of cement-bound wood particle boards with regard to their strength values. The thus obtained uniform density also guarantees a uniform thickness and considerably smaller fluctuations in the strengths of the series-manufactured boards.

Furthermore, the two-part or twice measuring of the mass (weight) of the bulk material according to the invention results in a smoothing of the surface of the bulk materila which so far in known devices has to be accepted as surface undulations which are control-related.

## CLAIMS

1. A method of metering bulk material for the manufacture of cement-bound wood particle boards, in which the bulk material is discharged from a bin and then volumetrically metered on a circulating belt and brought through a spreading device onto a forming belt, wherein the bulk material is weighed and volumetrically metered on a premetering belt

and is then spread onto a downstream fine metering belt on which it is again weighed and volumetrically metered, and is then spread onto the downstream forming belt.

2. A method according to claim 1, wherein the weights are measured of the bulk material disposed on the premetering belt and on the fine metering belt before the respective volumetric metering of such bulk material.

3. A method according to claim 1 or claim 2, wherein the discharge of material from the bin is controlled as a function of the measurement of the weight of the bulk material on the premetering belt and the speed of the premetering belt is controlled as a function of the measurement of the weight of the bulk material on the fine metering belt.

4. A method according to claim 3, wherein the speeds of the bin discharge device of the premetering belt and of the fine metering belt are adjustable.

5. A method according to any one of claims 1 to 4, wherein the speeds of the devices effecting the volumetric metering of the bulk material are adjustable.

6. A device for metering bulk material for the manufacture of cement-bound wood particle boards, having a bin for the bulk material, at least one discharge device, and a downstream metering belt on which is disposed at least one volumetric metering device and a spreading device, wherein disposed in the spreading region of a spreading device of a premetering belt is a fine metering belt with a respective spreading device and a respective volumetric metering device, wherein the premetering belt and the fine metering belt are each provided with a weight-measuring means for the bulk material thereon.

7. A device according to claim 6, wherein the premetering belt and the fine metering belt are each provided with a respective volumetric metering device.

8. A device according to claim 7, wherein each volumetric metering device comprises a skimming roller.

9. A device according to any one of claims 6 to 8, wherein the bin discharge device and the or each volumetric metering device is height-adjustable in relation to the corresponding belt.

10. A device according to any one of claims 6 to 9, wherein the speed of the bin discharge device and the or each volumetric metering device is controllable.

11. A device according to any one of claims 6 to 10, wherein the bin discharge device is in the form of a skimming roller.

12. A device according to any one of claims 6 to 11, wherein in its region near the respective spreading device the premetering belt is mounted on a stationary support, and the other end of the premetering belt is connected to a weight-measuring means.

13. A device according to any one of claims 6 to 12, wherein the fine metering belt is mounted on a support in its region near the respective spreading device and the other end of the fine metering belt is connected to a weight-measuring means.

14. A device according to any one of claims 6 to 13, wherein the weight-measuring means of the premetering belt is connected to the drive of the bin discharge device and the weight-measuring means of the fine metering belt is connected to the drive of the premetering belt whereby the quantities of bulk material on both belts are controllable.

15. A device according to any one of claims 6 to 14, wherein the delivery speeds of the discharge device, the premetering belt and the fine metering belt are adjustable.

16. A device according to any one of claims 6 to 15, wherein the weight-measuring means are load cells.

17. A device according to claim 12 and claim 13, wherein the fixed mountings of the premetering belt and of the fine metering belt are each formed by a transverse support and the premetering belt and the fine metering belt pass around respective drive and support rollers which are positionally movable.

18. A method of metering bulk material substantially as hereinbefore described.

19. A device for metering bulk material substantially as hereinbefore described with reference to and as illustrated in the accompanying drawing.

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